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Status of shoot fly (*Atherigona* spp.) incidence in wheat in major wheat growing districts of North Karnataka

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Abstract
Shoot flies (*Atherigona* spp.) are the members of muscidae family which have got economic importance as pest of several crops of Gramineae. During the recent past, crops like wheat, maize and bajra are suffering by shoot fly infestation with considerable economic damage to the crops. In this context, roving survey was conducted twice during *rabi* 2019-20 to know status of shoot fly incidence in major wheat growing districts of North Karnataka. The results revealed that the mean dead heart damage of shoot fly ranged from 12.41 to 26.62 per cent in different districts surveyed. The maximum shoot fly infestation of 26.62 per cent was reported in Dharwad followed by Vijayapura (17.38%), Bagalkot (13.26%) and least incidence was noticed in Belagavi district (12.41%). Irrespective of the districts, late sown wheat crop (last week of December) suffered greatly than the early sown (first week of October) or normal sown wheat crop (first week of November).

Keywords: dead heart, North Karnataka, shoot fly, wheat

Introduction
Wheat (*Triticum* spp.) is a cereal grain which is a staple food in the world and has been known as the "King of Cereals" for centuries because of the land it occupies, higher production and has a prominent role in the international market in the food grain trade. It is also called as "versatile cereal food" as it continues to maintain its pride of place with origins that ramify with evolutionary history along with human society. Wheat is less attacked by insect pests in field as compared to other food grain crops. Even though, insect pests and diseases together reported to cause 20 to 37 per cent yield loss (Pimentel, 1997) [9]. In global perspective, there are 26 insect pests reported to damage wheat crop, while 12 species have been reported from Indian sub-continent which infest from planting to till harvest of the crop (Anon., 2013) [1]. According to Duveiller *et al.* (2007) [5] usually chewing and feeding insects do not cause major direct damage in wheat unless their population reaches to peak level. However, shoot fly (*Atherigona soccata* Malloch), pink stem borer (*Sesamia inferens* Walker), termites (*Odontotermus obesus* Rambur and *Microtermus obesus* Holmgren) and cut worms (*Agrotis ipsilon* Hufnagel) are causing significant damage in wheat by producing dead heart and white ear symptoms at vegetative and reproductive stage of the crop, respectively. During the recent past, insect pests like termites, aphids and shoot fly are becoming major threat to wheat cultivation in Karnataka. More than 26 per cent of the dead heart incidence was reported due to shoot fly alone (Anon., 2013) [1] and becoming a major threat to wheat production in irrigated belt of North Karnataka. In this context, an attempt was made to document the status of shoot fly incidence in major revenue districts of North Karnataka in which wheat is being cultivated under irrigated condition.

Materials and Methods
The roving survey was carried out twice during *rabi* 2019-20 in major wheat growing districts of North Karnataka which covers Belagavi, Dharwad, Bagalkot and Vijayapura. The survey was undertaken twice, once during November last week to document the initial shoot fly damage in early sown wheat crop whereas, second survey was carried out during last week of December in which late sown wheat fields were observed for evaluating the incidence level.
In each district, two to three major wheat growing taluks were selected based on area under wheat. In each taluk, two or three villages in which wheat was growing as a sole crop under irrigated condition were chosen. Two to three fields, minimum of one acre from each village were investigated by selecting two spots randomly from each field which consists of hundred plants per spot.

The observations were made on hundred selected plants for documenting the dead heart damage and same was expressed in percentage by using the following formula.

$$\text{Dead heart (\%)} = \frac{\text{Number of plants showing dead heart}}{\text{Total number of plants observed}} \times 100$$

Dead heart damage is characterised by deformed stunted growth of the plant caused by borers on the region immediately behind the growing bud which results in the drying up of entire central shoot of the plant during the vegetative growth period with profused side tillers, not necessarily productive one. The dead heart due to shoot fly infestation can be differentiated from the similar damage caused by stem borers, where the foul smell is experienced due to dead plant tissues in shoot fly which is absent in the other borers.

Results and Discussion

The variation in the shoot fly incidence across major wheat growing districts of North Karnataka which was documented through two consequent roving surveys is depicted in table 1 and Figure 1.

The survey conducted during *rabi*, 2019-20 indicated that in Dharwad district during the first survey, the dead heart due to shoot fly in wheat ranged between 22.86 to 27.36 per cent. The peak incidence was reported from Yettinagudda village (27.36%) followed by Hebballi (26.89%), Narendra (25.13%), Annigeri (24.31%) and the least was noticed in Bhadrapur (22.86%). During the second survey, the incidence level ranged between 25.34 to 31.24 per cent. Hebballi village witnessed highest shoot fly incidence with 31.24 per cent dead heart followed by Yettinagudda (30.46%), Annigeri (26.34%), Bhadrapur (26.21%) and least incidence was registered in Narendra (25.34%) village. Among the two taluks surveyed, Dharwad taluk reported 27.74 per cent mean shoot fly incidence followed by Annigeri (24.94%). The mean dead heart incidence due to shoot fly in Dharwad district was reported to be 26.62 per cent (Table 2).

In Belagavi district, dead heart incidence due to shoot fly ranged between 9.56 to 12.31 per cent and the maximum infestation reported in Kempwad village (12.31%) followed by Nerli (11.39%), Sankeshwar (10.58%). However, Kakamari reported least shoot fly incidence of 9.56 per cent during the first survey. In the second survey, shoot fly damage ranged between 10.35 to 15.56 per cent. Nerli village recorded maximum dead heart (15.56%) followed by Kempwad (15.21%), Sankeshwar (14.32%) and least in Kakamari (10.35%). Among the two taluks of Belagavi district, Hukkeri recorded more shoot fly incidence (12.97%) than Athani (11.86%). The mean shoot fly infestation in Belagavi district was 26.62 per cent (Table 2).

In Bagalkot district during the first survey, the shoot fly damage ranged between 8.93 to 14.01 per cent. The maximum dead heart incidence was reported from Kumbarhal (14.01%) followed by Mudhol (12.53%), Muranal (12.52%), Adihudi (12.12%), Chinchakhandi (10.61%), Hirepadasalagi (10.31%) and the least damage of 8.93 per cent was recorded in Kaladgi. The shoot fly damage ranged between 10.54 to 20.21 per cent during second survey and the maximum was noticed in Kumbarhal (20.21%) followed by Adihudi (17.56%), Mudhol (16.21%), Chinchakhandi (14.84%), Muranal (13.54%), Hirepadasalagi (11.58%) and least dead heart symptom was recorded from Kaladgi village (10.54%). Among the three taluks, Jamkhandi recorded highest shoot fly damage with 14.30 per cent dead heart incidence followed by Mudhol (13.55%) and the least incidence was noticed in Bagalkot taluk (11.39%). The mean dead heart incidence of 13.26 per cent was registered in Bagalkot district due to shoot fly infestation.

In Vijayapura district, the peak incidence was reported from Hallada Gennur (24.12%) followed by Kambagi (14.68%), Nagaradinni (12.34%) and Mamadapur (7.57%). The least was noticed in Kolhar village (5.50%) with an overall damage between 5.50 to 24.12 per cent during last week of November. During the second observation, shoot fly incidence in wheat ranged between 14.89 to 29.54 per cent with a highest damage of 29.54 per cent in Hallada Gennur followed by Nagaradinni (24.87%), Kambagi (21.38%), Kolhar (18.87%) and the least being in Mamadapur (14.89%). Among the two taluks of Vijayapura, Basavana Bagewadi reported 19.21 per cent mean incidence followed by Vijayapura (14.64%) with district mean dead heart incidence of 17.38 per cent.

Among the four districts surveyed for the incidence of shoot fly in wheat, maximum infestation was recorded in Dharwad during both the intervals of November and December (25.31 and 27.92%) followed by Vijayapura (12.84 and 21.91%), Bagalkot (11.58 and 14.93%) and Belagavi (10.96 and 13.86%). The pooled mean dead heart incidence of both the surveys was also highest in Dharwad district (26.62%) followed by Vijayapura (17.38%), Bagalkot (13.26%) and Belagavi (12.41%) (Table 2). This variation in the level of shoot fly incidence might be due to difference in sowing date of wheat in all the four districts surveyed, disparity among cultivars used, cultural practices, distribution of weather elements (temperature, rainfall and relative humidity) coupled with geographical variation and edaphic factors which may have the direct impact on the level of shoot fly infestation. The effect of climatic factors on shoot fly incidence was documented by Balikai (2000) [2] who noticed the activity of *Atherigona soccata* in sorghum greatly influenced by extreme temperature (above 35 ^{0}C and below 18 ^{0}C), continuous rainfall and observed significant positive correlation with evening relative humidity.

Table 1: Shoot fly incidence in wheat in North Karnataka during *rabi* 2019-20

Sl. No.	District	Taluk	Villages	Dead heart (%)		
				Last week of November 2019	Last week of December 2019	Mean
1	Dharwad	Dharwad	Hebballi	26.89	31.24	29.07
			Narendra	25.13	25.34	25.24
			Yettinagudda	27.36	30.46	28.91
		Annigeri	Annigeri	24.31	26.34	25.33
			Bhadrapur	22.86	26.21	24.54
		Mean		25.31	27.92	26.62
2	Belagavi	Athani	Kempwad	12.31	15.21	13.76
			Kakamari	9.56	10.35	9.96
		Hukkeri	Sankeshwar	10.58	14.32	12.45
			Nerli	11.39	15.56	13.48
		Mean		10.96	13.86	12.41
3	Bagalkot	Bagalkot	Muranal	12.52	13.54	13.03
			Kaladgi	8.93	10.54	9.74
		Jamkhandi	Hirepadasalagi	10.31	11.58	10.95
			Kumbarhal	14.01	20.21	17.11
			Adihudi	12.12	17.56	14.84
		Mudhol	Mudhol	12.53	16.21	14.37
			Chinchakhandi	10.61	14.84	12.73
		Mean		11.58	14.93	13.26
4	Vijayapura	Vijayapura	Kambagi	14.68	21.38	18.03
			Mamadapur	7.57	14.89	11.23
		Basavana Bagewadi	Nagaradinni	12.34	24.87	18.61
			Hallada Gennur	24.12	29.54	26.83
			Kolhar	5.50	18.87	12.19
		Mean		12.84	21.91	17.38

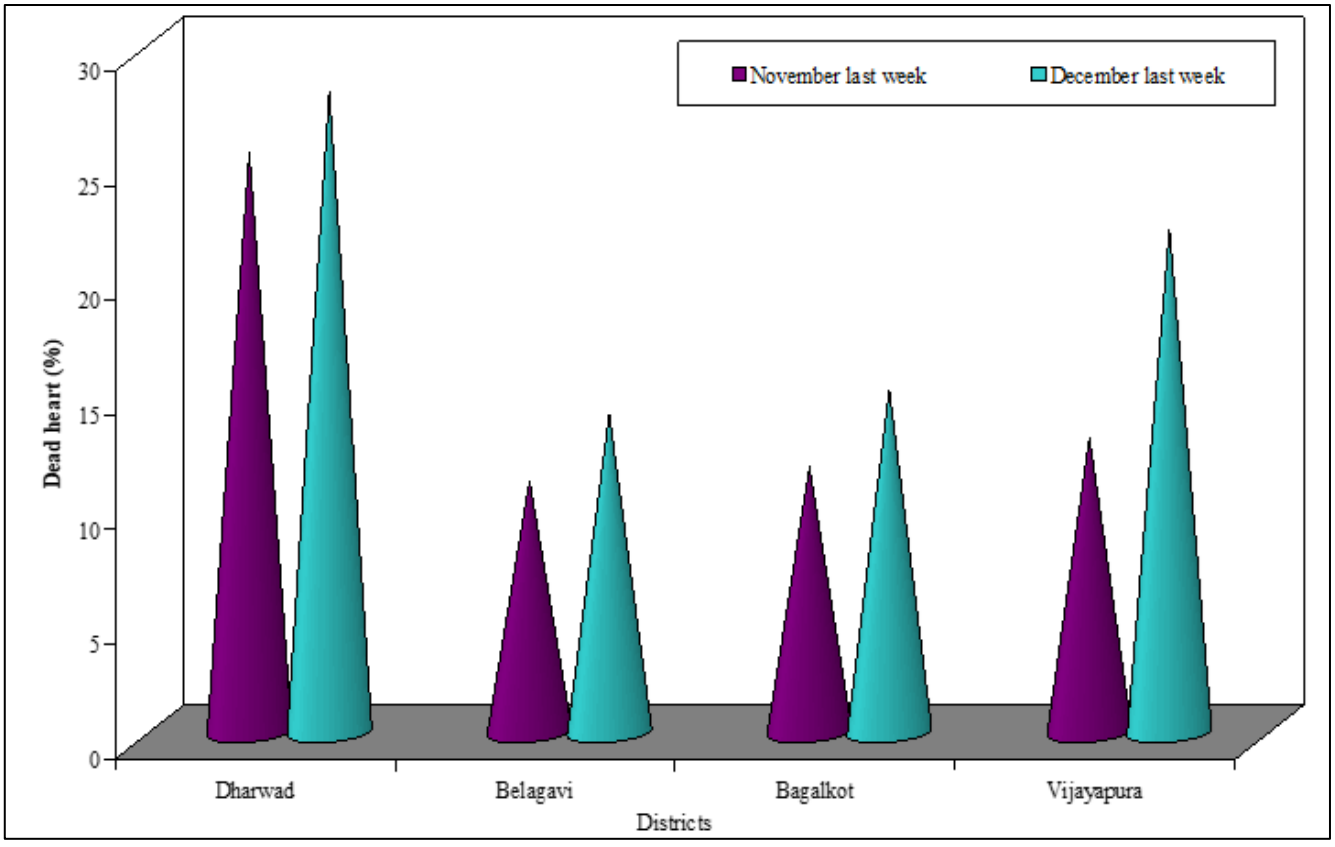

Fig 1: Incidence of shoot fly in wheat in different districts of North Karnataka

Table 2: Mean incidence of shoot fly in wheat in different districts of North Karnataka

Sl. No.	District	Taluk	Dead heart (%)		
			November last week	December last week	Mean
1	Dharwad	Dharwad	26.46	29.01	27.74
		Annigeri	23.59	26.28	24.94
		Mean	25.31	27.92	26.62
2	Belagavi	Athani	10.94	12.78	11.86
		Hukkeri	10.99	14.94	12.97
		Mean	10.96	13.86	12.41
3	Bagalkot	Bagalkot	10.73	12.04	11.39
		Jamkhandi	12.15	16.45	14.30
		Mudhol	11.57	15.53	13.55
		Mean	11.58	14.93	13.26
4	Vijayapura	Vijayapura	11.13	18.14	14.64
		Basavana Bagewadi	13.99	24.43	19.21
		Mean	12.84	21.91	17.38

Irrespective of the districts, the late sown wheat crop (last week of December) suffered more as compared to the early sown (first week of October) or timely sown crop (first week of November). Karibasavaraja and Balikai (2006) [6] conducted a survey on pests of sorghum in Dharwad area and recorded potential damage of shoot fly which ranged from 43.1 to 93.4 per cent dead heart which is in close collaboration with the present outcomes. An extensive survey conducted throughout India (Bhagwat *et al*., 2007) [4] indicated moderate infestation of sorghum shoot fly (15-40%) in Karnataka. In another study, he recorded peak incidence of 32 per cent dead heart due to sorghum shoot fly at seedling stage in Dharwad district (Bhagwat *et al*., 2011) [3] which is in agreement with the present findings. Ningaraj (2015) [8] reported maximum dead heart incidence of 21.85 per cent in Dharwad district followed by Belagavi (18.42%), Haveri (17.51%) and Gadag (16.50%) due to shoot fly in wheat. In another study, Madigar (2018) [7] noticed 36.00 per cent dead heart damage in sorghum, 33.20 per cent in proso millet and 6.40 per cent in finger millet in Dharwad district which supports the results of present findings and explains the potentiality of shoot fly to cause extensive damage in different cereals and millet crops.

Conclusion

The results of the present study explore the changed pest scenario of wheat in which farmers usually do not practice the plant protection measures against insect pests. But the present investigation provides elementary knowledge on present pest status to plant protection experts to look over the upcoming surge.

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